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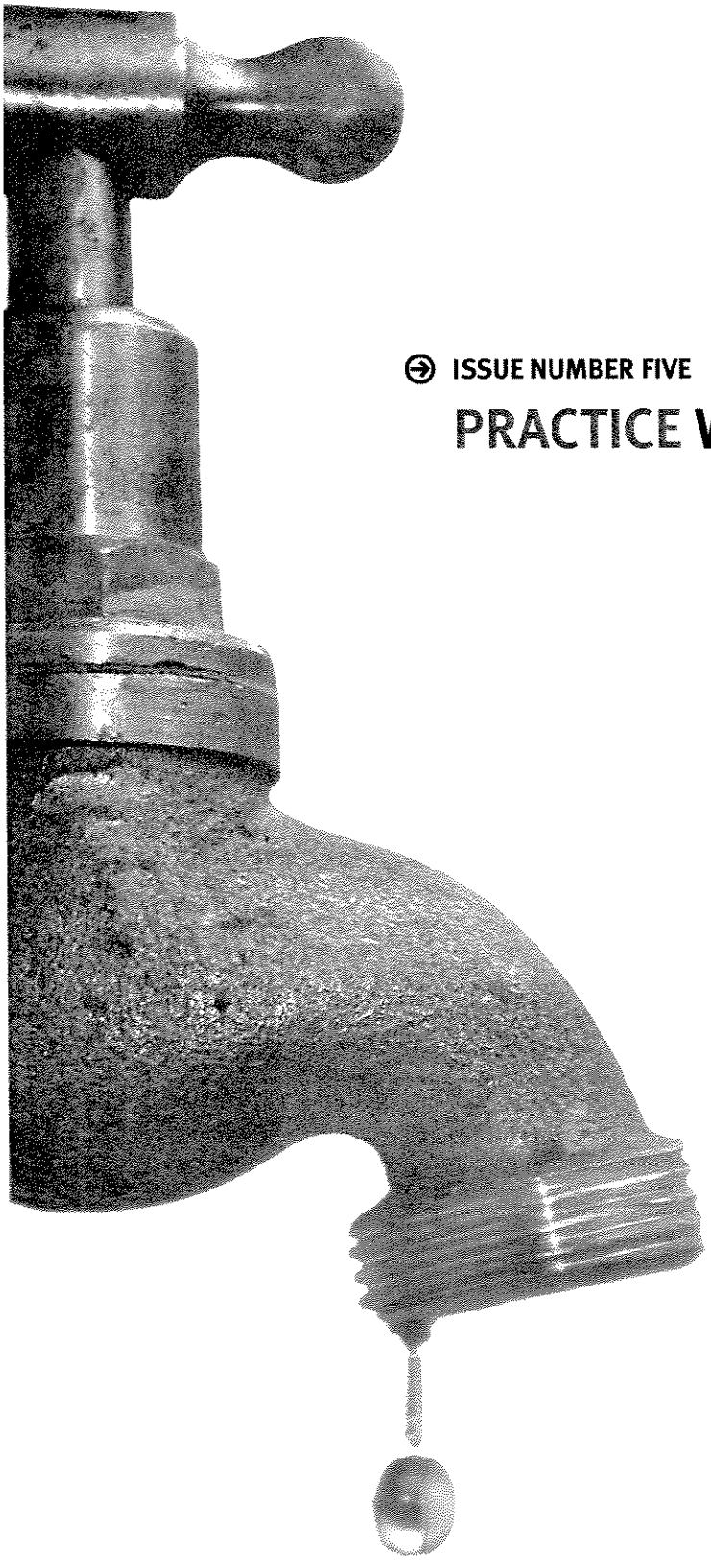
AMERICAN PLANNING ASSOCIATION



ISSUE NUMBER FIVE

PRACTICE WATER CONSERVATION

5

How Thirsty Is Your Community?

By Paula Van Lare

Water shortages are no longer exclusive to the Desert Southwest.

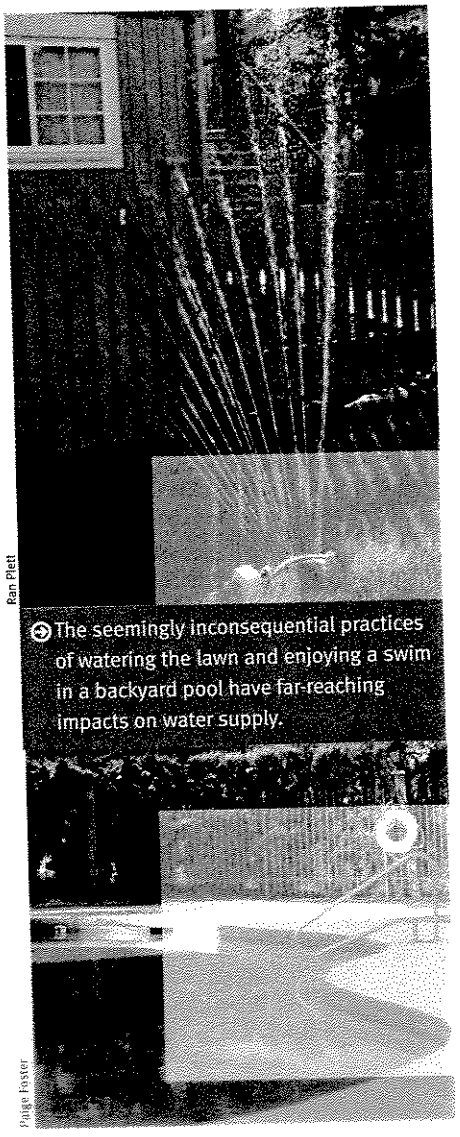
Today, escalating infrastructure costs and tight supplies of drinking water plague communities across the country. Older cities with 100-year-old pipes face replacement costs, while newer, growing cities scramble to keep up with demand.

According to the EPA, maintaining and replacing drinking water infrastructure will cost water utilities $274 billion between 2000 and 2019. The utilities simply cannot afford the costs. Even if the utilities raise rates by 3 percent each year for the next 20 years, they still would fall $45 billion short. In many areas, rapid growth strains budgets and available freshwater supplies. For example, Alabama, Florida, and Georgia are stalemated in their attempts to divide the Chatahoochee River flow among the states and their growing urban populations.

Local governments have several options available for providing drinking water, especially for new developments. Most cities now impose impact fees on developers to cover the cost of new infrastructure. In several states, most notably Florida, local governments charter community development districts to provide infrastructure for new developments.

Some utilities adopt pricing policies to cover the costs of providing water and to provide incentives for reducing water use, including prices that increase at higher levels of use and higher prices during high-demand summer months. These strategies help to address the rising cost of infrastructure and blunt the increase in demand. Despite such efforts, experts expect demand to rise, straining water supplies in virtually all regions of the U.S.

Past attempts to rein in water demand focused on improving metering, fixing leaks, and using indoor conservation technologies such as low-flow showers and toilets. These efforts have unquestionably borne fruit. In Boston, for example, these measures eliminated (or at least substantially postponed) the need for a new reservoir that would have tapped a watershed in western Massachusetts. However, control measures for outdoor water use remain largely absent from community agendas except in the arid western states and during times of drought in the East. In addition, the role of development patterns in shaping water demand and cost is hardly addressed at all.



Ran Plett

Paige Foster

The seemingly inconsequential practices of watering the lawn and enjoying a swim in a backyard pool have far-reaching impacts on water supply.

This issue of *Zoning Practice* shows how urban form affects the demand for and cost of drinking water. It will draw on a variety of studies showing how lot size is a particularly important determinant of water demand and cost, as is the dispersion of developments. Both factors are of interest to planners and municipal code writers.

[LOT] SIZE MATTERS

Studies show that lot size is a determinant in residential and commercial water use—with all else being equal, homes and businesses on larger lots use more water. Lawn care, car washing, swimming pools, and other outdoor uses can account for 50 to 70 percent of household water use. According to the American Water Works Association, lawn care alone accounts for an average of 50 percent of all household water use nationally. Office buildings also use significant quantities of water for landscaping. The U.S. Geological Survey notes, "lawn watering and air conditioning use more water than sanitation or cleaning" in commercial buildings.

Examples of the relationship between lot size and water use are plenty. Utah planners determined that water demand drops from approximately 220 gallons per capita per day at a density of two units per acre to about 110 gallons per capita per day at a density of five units per acre. In a study of household water use in Sacramento, California, water demand by unit in the Metro Square development (a neighborhood of 46 single-family homes on compact lots) was 20 to 30 percent lower than less dense developments of roughly the same

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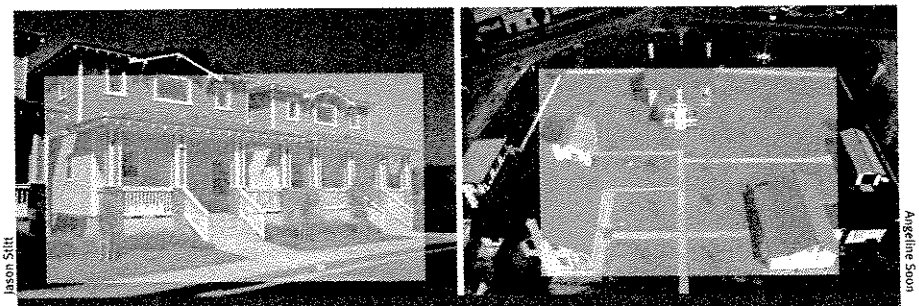
About the Author
Paula Van Lare is a policy analyst in the U.S. EPA's Development, Community, and Environment Division. She focuses on water resource issues and state smart growth policies. The views in this article are her own and do not reflect EPA policy.

number of units. A study of Seattle-area households found that a home on a 6,500-square-foot lot uses 60 percent less water than one on a 16,000-foot lot.

Large lot size also increases the length of the pipes needed to serve households and commercial buildings, and greater length means greater costs. A recent study in the *Journal of the American Planning Association* used an engineering cost model to assess the influence of land use on the cost of water distribution and sewer services. The study estimated annual water costs at $143 for a household located on a 0.25-acre lot in a compact development near the water supply plant. If the household moved to a one-acre lot in a similar location, its annual water costs would be $272, even if the household maintained the same water usage. If that same household used the same amount of water on a one-acre site in a dispersed development far from the service center, its water service would cost $388 annually. Because this comparison assumes all households use the same amount of water, the difference reflects only the cost of infrastructure and pumping and not the cost of water consumption for the larger lawns on larger lots.

The *JAPA* study found that infrastructure and pumping costs of water service are more sensitive to lot size than any other factor. The principal reason for this difference is that longer distribution mains are required to distribute water from transmission mains under the lot and into the home. Costs for transmission mains that transmit water from the plant to the development are more expensive for developments farther away from the water supply source, but transmission mains accounted for an average of only 16 percent of the total infrastructure and pumping costs.



Jason Stitt

Angeline Soon

Which development pattern conserves more water?

In *Costs of Sprawl*, published in 2000 by the National Research Council, fiscal impact analysis expert Robert Burchell and a team of researchers at Rutgers University developed detailed national models and estimates of infrastructure costs under a "business as usual" approach and more compact development. Burchell estimates that more compact growth nationwide would save $4.77 billion, or 6.5 percent of total water infrastructure costs, from 2000 to 2025. The savings would be particularly significant in southern and western areas of the U.S., where growth is greatest.

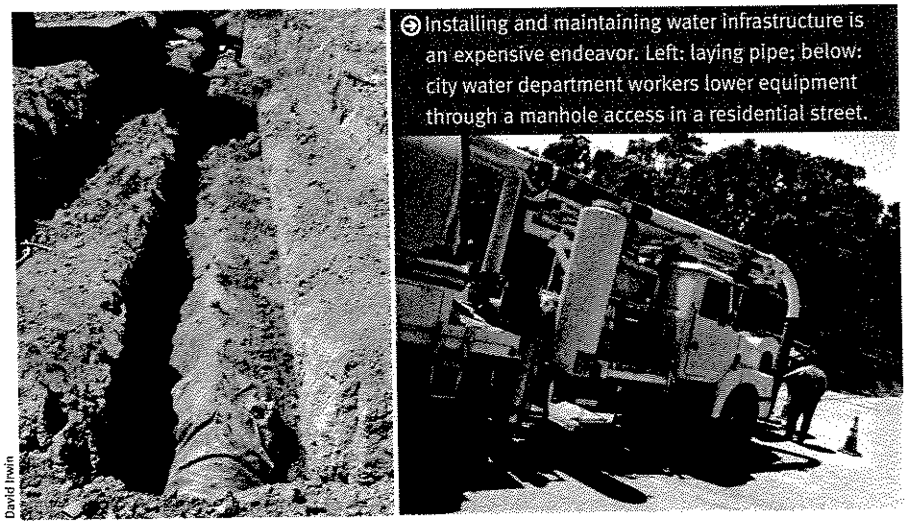
LEAKAGE

All water systems leak through pipes and at joints. Depending on the condition of the infrastructure, a drinking water system can lose from 6 percent to more than 25 percent of its water through leaks and breaks. Longer systems leak more than shorter ones, and less compact communities require longer systems. As development moves into low-density areas, communities continue to build water systems that are inherently more prone to leakage over time.

System pressure also contributes to leakage, and those operating at higher pressures over longer periods leak more. Systems in low-density areas must use higher pressures to push water through longer mains. Because low-density areas tend to have a higher water demand for lawns, dry months require pressure increases. When the central pumping station sits on the urban fringe, nearby low-density users leak less than more distant users. Nonetheless, highly dispersed communities incur greater losses overall than do more compact communities with centrally located water service centers.

The amount of water lost to leaks is difficult to measure and varies widely among individual systems. Reliable national estimates of leakage are rare, but operators of local systems put greater emphasis on eliminating leaks now that water scarcity is a real and present threat. The Kansas Water Authority articulates the problem well:

> Lost water is lost money. . . . If losses are caused by leaks, you've lost the money it cost to produce or purchase that water. In some cases, curbing large water losses from leaks can save a town or district the cost of finding additional water sources. Wasted water means wasted dollars.



Installing and maintaining water infrastructure is an expensive endeavor. Left: laying pipe; below: city water department workers lower equipment through a manhole access in a residential street.

David Irwin

Lisa McDonald

Broward County, Florida, aggressively seeks out and fixes leaks as part of its efforts to expand water supply to keep up with growth. The county effectively reduced leakage from about 20 percent in 1990 to 10 percent in 2004, saving about $5,000 and 2,900 gallons of water per day. Unfortunately, smaller towns often lack the resources to identify and fix leaks. In 1987, the Massachusetts Water Resources Authority created a leak detection and repair program to help the Boston area conserve water and reduce the need for a new reservoir. The program has reduced leakage from approximately 25.6 million gallons per day during the early 1990s to around 10 million gallons per day in 2004.

Water losses, which include water lost to leaks, theft, and metering errors, are easier to measure. Water systems in the U.S. lose about six billion gallons of water per day. Drinking water systems under local ownership lose a total of $800 million per year. Four years after setting the goal of a less than 15 percent water loss for local systems, the Kansas Water Board conducted a follow-up survey that revealed varied progress. The state's eight regions reported average losses of between 9 and 20 percent. Sixty-one of the 768 local systems reported losses over 30 percent, while other systems reported losses below 3 percent. The American Water Works Association recommends that system losses should remain under 10 percent.

NOT JUST LOT SIZE

Incentives and regulations that encourage residential landscaping with minimal irrigation needs can help mitigate the impacts of lot size on water demand and consumption. Las Vegas pays homeowners one dollar for every square foot of turf removed. Other municipalities (most of them in the West) adopted landscaping ordinances requiring landowners to use plants adapted to the local climate. Volusia County, Florida, restricts the amount of irrigated grass for new homes. Homeowners using native vegetation without irrigation needs can cover a larger percentage of the yard with grass.

> Incentives and regulations that encourage residential landscaping with minimal irrigation needs can help mitigate the impacts of lot size on water demand and consumption.

Unfortunately, landscaping ordinances in many communities exclude single-family homes, which are a principal contributor to overall outdoor water use. Furthermore, many homeowners associations require residents to plant and maintain "thirsty" turf, even in dry areas. Planners should determine if such requirements are a barrier to water conservation, and when to bring them to the attention of other policymakers and elected officials.

Several major water utilities provide technical advice for homeowners who are willing to use water-efficient landscaping and native plants. Local governments may want to set an example by "greening" public facilities, including rooftop gardens and eco-roofs (see "Building Green: Onus or Bonus?" April 2005). Denver's water board recently began a rebate program for homeowners who purchase trees and shrubs with low water needs.

Commercial facilities (especially large office parks) stand to gain considerably by using native plants that require less water, fertilizer, and pesticides. Conservation Design Forum, an Illinois-based landscape design firm, estimates that sustainable commercial landscaping costs half as much to install and maintain as traditional commercial landscapes of turf, ornamental shrubs, and transplanted trees.

POLICY OPTIONS

While water-conserving landscaping can ease the demand for water, large lots still contribute to higher infrastructure costs and additional leakage from longer pipes. Planners and elected officials have a variety of policy measure options to help solve the problem.

Communities nationwide use smart growth principles to address a variety of goals,

[illegible] Left: coastal plants in a seaside development; right: [illegible] in the Southwest.

THE SMART GROWTH PRINCIPLES

The Smart Growth Principles are a guiding force for the Smart Growth Network, a coalition of organizations that includes the U.S. Environmental Protection Agency, American Farmland Trust, National Association of Realtors, Fannie Mae, International City/County Management Association, Institute of Transportation Engineers, and others. The principles serve as a framework for growth, resulting in the efficient use of resources and the development of attractive, healthy, safe, and vibrant neighborhoods where residents can enjoy a high quality of life. The principles:

- Mix land uses;
- Take advantage of compact building design;
- Create a range of housing opportunities and choices;
- Create walkable neighborhoods;
- Foster distinctive, attractive communities with a strong sense of place;
- Preserve open space, farmland, natural beauty, and critical environmental areas;
- Strengthen and direct development towards existing communities;
- Provide a variety of transportation choices;
- Make development decisions predictable, fair, and cost effective; and
- Encourage community and stakeholder collaboration in development decisions.

including reducing water cost and demand. For example, compact building design and walkability both favor smaller lots and keep water users closer together. Communities that encourage climate-appropriate landscaping also create a stronger sense of place, one of being part of a particular eco-region rather than struggling to imitate the broad green lawns of Britain.

Fix-it-first. The "fix-it-first" approach to infrastructure management is one way to encourage the smart growth principle of directing development to existing communities. Poorly maintained, decaying infrastructure contributes to the abandonment of many city cores and inner-ring suburbs. It also inhibits redevelopment. Tending to existing infrastructure with routine maintenance and proper upgrades may help attract new residents and businesses to these areas. Healthy systems (even old ones) often can accommodate new growth and infill development, which save on the capital expenses of extending existing water networks or building new systems.

The U.S. EPA established state drinking water revolving funds to provide low-interest loans for water infrastructure. The loans are earmarked for upgrades and for the replacement of failing systems in existing communities. States administer the revolving funds and set funding priorities. The loans provide a valuable source of funding for local systems but, unfortunately, the demand for them is greater than the supply.

Fix-it-first is the adopted state policy in New Jersey, Maryland, Pennsylvania, Tennessee, Illinois, Michigan, Wisconsin, California, Oregon, and Washington. Maryland encourages growth in urban areas by helping to pay for upgrades in city water infrastructure systems. The Maryland program provides financial assistance for local governments to correct inadequate water supply systems such as aging and poorly operating water treatment facilities. The money helps to replace leaking water mains, repair or replace storage tanks, connect residences with contaminated or inadequate wells to city water, and upgrade existing water facilities to meet current federal and state standards.

Unfortunately, fix-it-first policy implementation is slow in most states because of preexisting policies and procedures. But as state and local budgets tighten further, it offers greater appeal.

Pricing. Two types of pricing strategy can affect water cost and demand. The first determines who pays for new infrastructure serving new development. The trend over the past 15 years has been to shift the cost of new infrastructure to developers, and ultimately, property buyers. Currently, 77 percent of drinking water utilities recover some or all of the cost of service extensions through developer contributions.

The second pricing strategy determines how much users pay for water consumption. For years, water prices in many areas failed to cover costs. The GAO estimated that in 2002, more than 25 percent of utilities failed to

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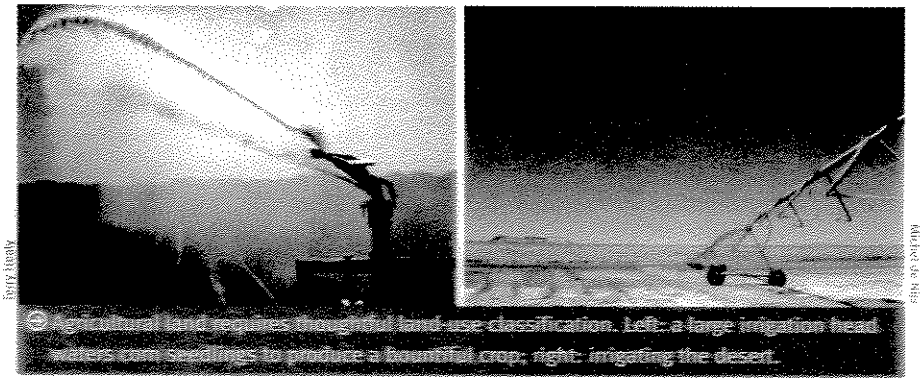


Jerry Healy

WEB RESOURCES

Non-Profit Water Resources

ENVIROLINK NETWORK
envirolink.netforchange.com

RIVER NETWORK
www.rivernetwork.org

SMART GROWTH NETWORK
www.smartgrowth.org

Professional Water Resources

AIR AND WASTE MANAGEMENT ASSOCIATION
www.awma.org

AMERICAN PUBLIC WORKS ASSOCIATION
www.apwa.net

AMERICAN SOCIETY OF CIVIL ENGINEERS
www.asce.org

AMERICAN WATER WORKS ASSOCIATION
www.awwa.org

AMERICAN WATER RESOURCES ASSOCIATION
www.awra.org

NATIONAL GROUNDWATER ASSOCIATION
www.ngwa.org

State Water Resources

THE POWELL CONSORTIUM
wrri.nmsu.edu/powell

SOUTHEAST REGIONAL CLIMATE CENTER
water.dnr.state.sc.us/climate/sercc

WESTERN COALITION OF ARID STATES
westcas.org

WESTERN GOVERNORS' ASSOCIATION
www.westgov.org

WESTERN STATES GOVERNORS COUNCIL
www.westgov.org/wswc

Federal Water Resources

U.S. EPA—GROUND WATER & DRINKING WATER
www.epa.gov/safewater

U.S. GEOLOGICAL SURVEY—NATIONAL WATER QUALITY ASSESSMENT PROGRAM
water.usgs.gov/nawqa

U.S. GEOLOGICAL SURVEY—REAL-TIME WATER DATA
waterdata.usgs.gov

U.S. GEOLOGICAL SURVEY—WATER RESOURCES OF THE UNITED STATES
water.usgs.gov

International Water Resources

INTERNATIONAL WATER ASSOCIATION
www.iwahq.org.uk

NATIONAL WATER RESEARCH INSTITUTE (CANADA)
www.nwri.ca

ENVISION UTAH QUALITY GROWTH IMPACTS

	Approaches	Baseline	Quality Growth	Quality Growth Savings
Water Demand	• Changes in lot size • Different allocation of population and employment across area • Use of conservation pricing (although overall price of water did not change)	298 gallons per day per capita	267 gallons per day per capita	0.4 percent
Cost of Infrastructure	• Reduced length of new pipes required • Expanded use of existing infrastructure through infill development	$2.629 billion (in 1999 dollars)	$2.087 billion (in 1999 dollars)	20.6 percent

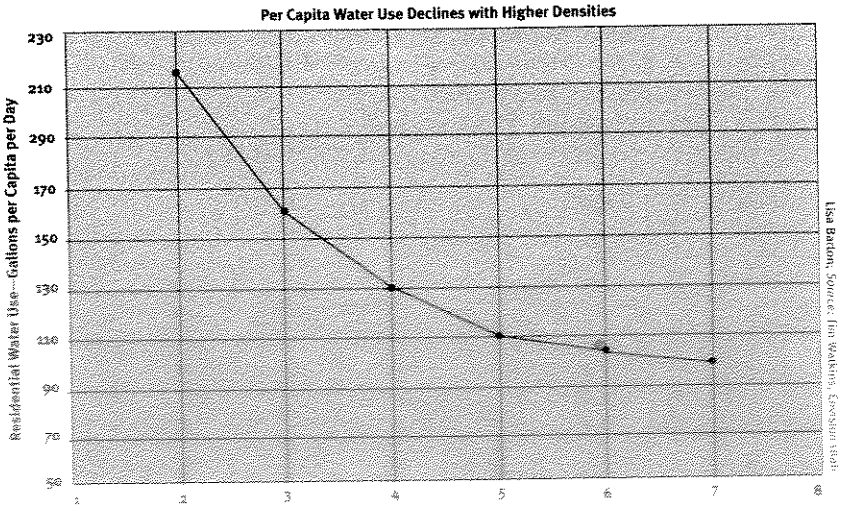
recover the cost of water from customers. As replacement and maintenance costs rise—the cost of building new plants to accommodate growth and meet new health standards is also rising—utilities continue to raise rates and establish rate schedules that encourage users to conserve water. Increasing block pricing, which charges more for water use above a certain level, encourages consumers to limit usage. Seasonal pricing, with higher rates during the summer, also encourages water-efficient landscaping.

SPOTLIGHT ON ENVISION UTAH

Envision Utah is a public-private partnership formed in 1997 to evaluate the economic, environmental, and quality-of-life benefits that smart—"quality"—growth could yield in the greater Wasatch area, home to 80 percent of Utah residents. Through extensive public participation and modeling, Envision Utah estimated the potential impacts of infill development, open space preservation, and mixed-use construction. The results were based on an estimated population increase from 1.7 mil-

WATER USE AND DENSITY

Per Capita Water Use Declines with Higher Densities



Lisa Barton, Source: Jim Wilkins, Envision Utah

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lion to 2.7 million residents by 2020 and were compared against a 1997 baseline approach that assumed no change in land development patterns or the management of natural resources. In both water demand and infrastructure cost, the quality growth strategy was an improvement over the current, conventional approach.

Envision Utah proposed four development scenarios for the project, ranging from low-density, auto-oriented development to very compact, transit-oriented development. The scenario with the greatest infrastructure cost savings was one in which new development and growth on unused land would be walkable and transit-oriented. In this scenario, there would be more infill and redevelopment and investments would be used to extend public transit systems and offer alternatives to the automobile.

This scenario also was the most effective in reducing per capita water demand. The Envision Utah study estimated that per capita water demand would decrease dramatically as development becomes more compact, from approximately 210 gallons per day at a density of two dwelling units per acre to roughly 110 gallons per day at five dwelling units per acre. Densities beyond the project's recommendation of five dwelling units per acre do not appear to significantly reduce per capita water demand any further.

The implications of water demand are far-reaching. While water demand may never be the primary determinant for lot size requirements or development pattern policies, citizens and elected officials alike must be aware of and understand the consequences of growth patterns on drinking water supplies. As the availability of water declines and infrastructure costs escalate, communities nationwide will have to consider the most efficient use of all their resources. Principles of smart growth are an effective guide.

Cover photo by Glen Jenkinson. Photo shows an isolated brass tap complete with drip.

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DO LARGE LOTS MEAN HIGHER WATER CONSUMPTION?

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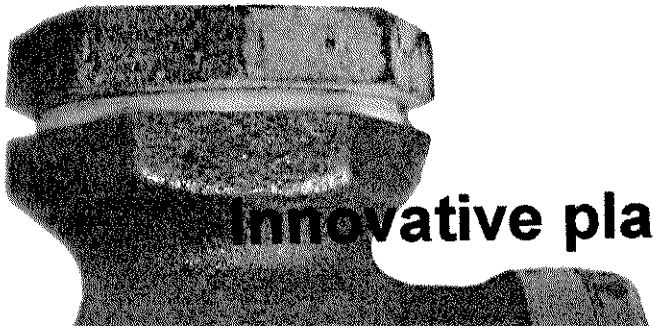

Innovative planning and zoning tools inside !